In [1]:

```
import seaborn as sns
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
sns.set(color_codes=True)
```

In [2]:

```
df = pd.read_csv("https://raw.githubusercontent.com/kishorekumar14/Fake_Currency_Detection/main/bank_notes.csv")
df.head()
```

Out[2]:

	variance	skewness	curtosis	entropy	Target
0	3.62160	8.6661	-2.8073	-0.44699	0
1	4.54590	8.1674	-2.4586	-1.46210	0
2	3.86600	-2.6383	1.9242	0.10645	0
3	3.45660	9.5228	-4.0112	-3.59440	0
4	0.32924	-4.4552	4.5718	-0.98880	0

In [3]:

```
df.shape
```

Out[3]:

```
(1372, 5)
```

In [4]:

```
df.isnull().sum().sum()
```

Out[4]:

```
0
```

In [5]:

```
df.describe()
```

Out[5]:

	variance	skewness	curtosis	entropy	Target
count	1372.000000	1372.000000	1372.000000	1372.000000	1372.000000
mean	0.433735	1.922353	1.397627	-1.191657	0.444606
std	2.842763	5.869047	4.310030	2.101013	0.497103
min	-7.042100	-13.773100	-5.286100	-8.548200	0.000000
25%	-1.773000	-1.708200	-1.574975	-2.413450	0.000000
50%	0.496180	2.319650	0.616630	-0.586650	0.000000
75%	2.821475	6.814625	3.179250	0.394810	1.000000
max	6.824800	12.951600	17.927400	2.449500	1.000000

In [6]:

```
sns.heatmap(df.isnull())
plt.title("Missing values?", fontsize = 20)
plt.show()
```

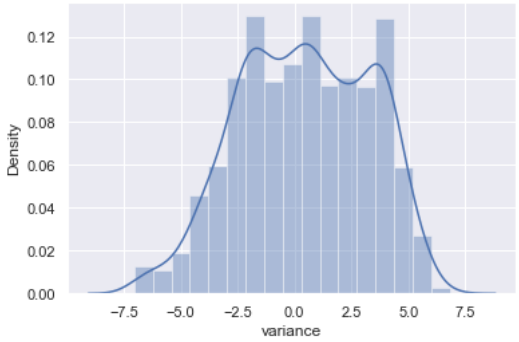
In [7]:

```
sns.distplot(df.variance)
```

```
C:\Users\KISHORE KUMAR A V\AppData\Local\Programs\Python\Python39\lib\site-packages\seaborn\distributions.py:2619: FutureWa
rning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `d
isplot` (a figure-level function with similar flexibility) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```

Out[7]:

```
<AxesSubplot:xlabel='variance', ylabel='Density'>
```



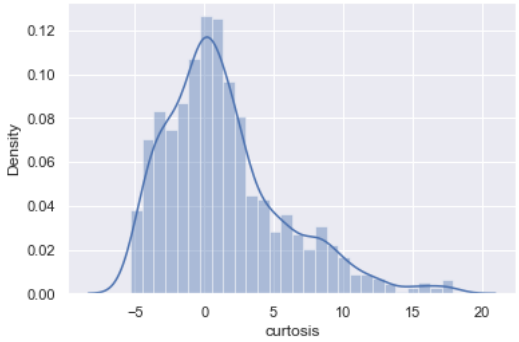
In [8]:

```
sns.distplot(df.curtosis)
```

```
C:\Users\KISHORE KUMAR A V\AppData\Local\Programs\Python\Python39\lib\site-packages\seaborn\distributions.py:2619: FutureWa
rning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `d
isplot` (a figure-level function with similar flexibility) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```

Out[8]:

```
<AxesSubplot:xlabel='curtosis', ylabel='Density'>
```



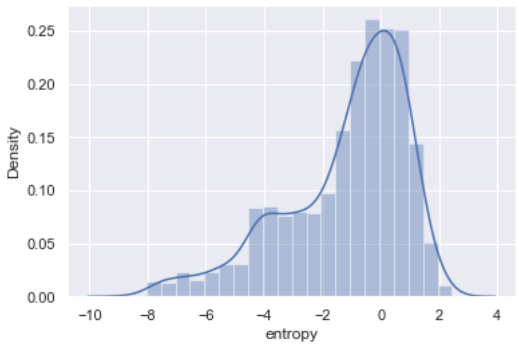
In [9]:

```
sns.distplot(df.entropy)
```

```
C:\Users\KISHORE KUMAR A V\AppData\Local\Programs\Python\Python39\lib\site-packages\seaborn\distributions.py:2619: FutureWa
rning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `d
isplot` (a figure-level function with similar flexibility) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```

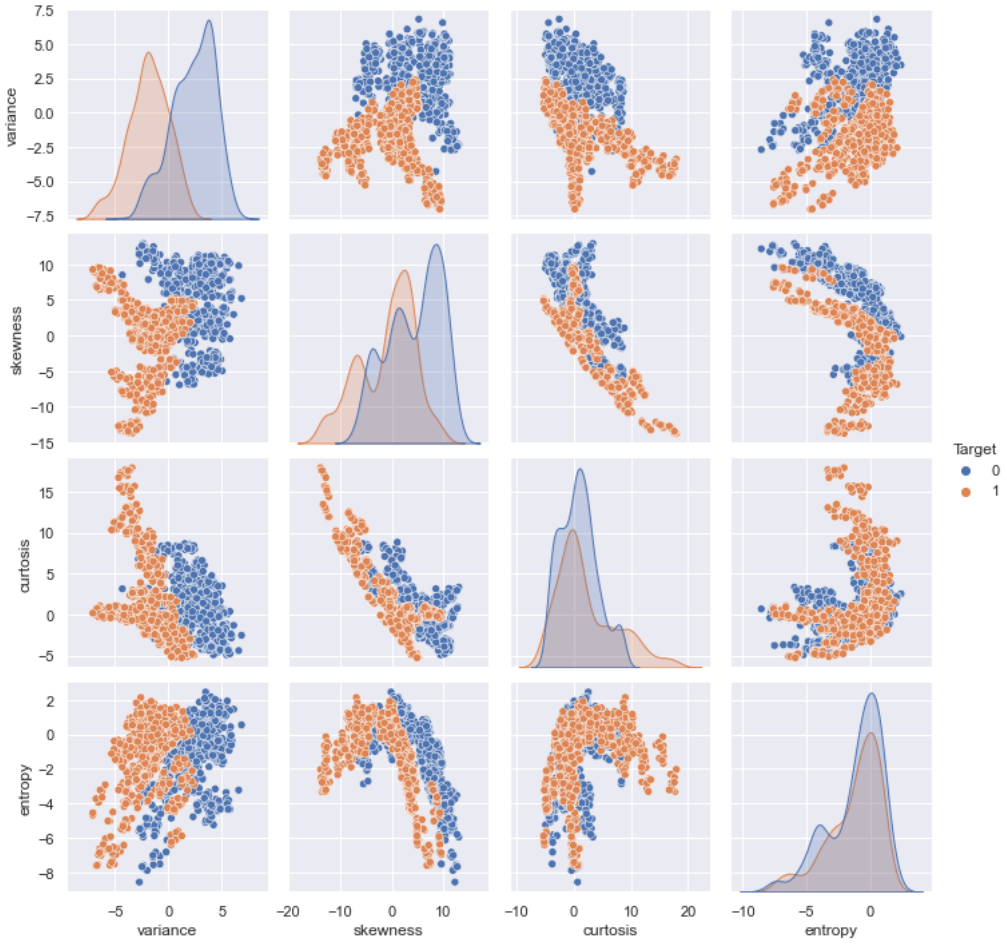
Out[9]:

```
<AxesSubplot:xlabel='entropy', ylabel='Density'>
```



In [10]:

```
# Pairwise relationships depending on target
sns.pairplot(df, hue = "Target")
plt.show()
```

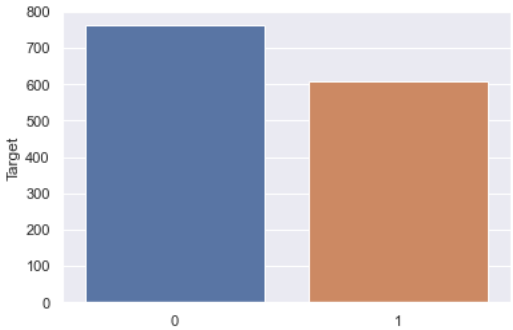


In [11]:

```
sns.barplot(x=df['Target'].value_counts().index,y=df['Target'].value_counts())
```

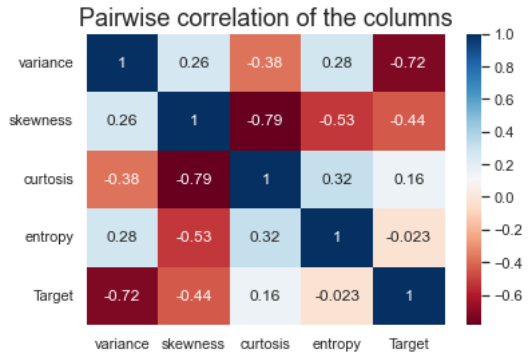
Out[11]:

```
<AxesSubplot:ylabel='Target'>
```



In [12]:

```
sns.heatmap(df.corr(), annot = True, cmap="RdBu")
plt.title("Pairwise correlation of the columns", fontsize = 18)
plt.show()
```



In [13]:

```
independent = df.iloc[0:,0:4].values
independent
```

Out[13]:

```
array([[  3.6216 ,   8.6661 ,  -2.8073 ,  -0.44699],
       [  4.5459 ,   8.1674 ,  -2.4586 ,  -1.4621 ],
       [  3.866  ,  -2.6383 ,   1.9242 ,   0.10645],
       ...,
       [ -3.7503 , -13.4586 ,  17.5932 ,  -2.7771 ],
       [ -3.5637 ,  -8.3827 ,  12.393  ,  -1.2823 ],
       [ -2.5419 ,  -0.65804,   2.6842 ,   1.1952 ]])
```

In [14]:

```
dependent = df.iloc[0:,4:].values
dependent
```

Out[14]:

```
array([[0],
       [0],
       [0],
       ...,
       [1],
       [1],
       [1]], dtype=int64)
```

In [15]:

```
from sklearn.model_selection import train_test_split
```

In [16]:

```
x_train, x_test, y_train, y_test = train_test_split(independent, dependent, test_size = 0.2, random_state = 43)
```

In [17]:

```
print("Size of training data :",x_train.shape)
print("Size of testing data :", x_test.shape)
```

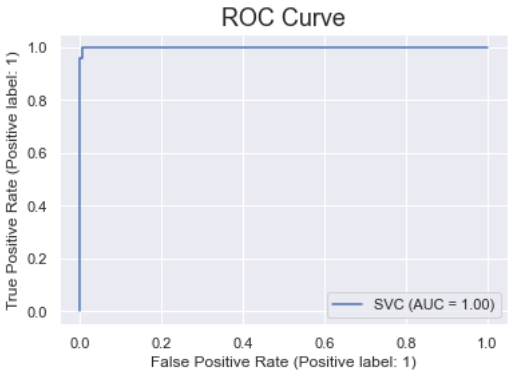
```
Size of training data : (1097, 4)
Size of testing data : (275, 4)
```

Support Vector Machine

In [18]:

```
# poly kernel
from sklearn.svm import SVC
svm = SVC(kernel = 'poly', random_state = 8)
svm.fit(x_train, y_train)

# Predicting the test set results
test_pred = svm.predict(x_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score
class_report = classification_report(y_test, test_pred)
conf_matrix = confusion_matrix(y_test, test_pred)
acc = accuracy_score(y_test,test_pred)

print("Classification report:\n\n", class_report)
print("Confusion Matrix\n",conf_matrix)
print("\nAccuracy\n","{0:.2f}".format(acc*100),"%")
results = []
results.append(("SupportVectorMachine",class_report, conf_matrix, acc))
from sklearn import metrics
metrics.plot_roc_curve(svm, x_test, y_test)
plt.title("ROC Curve", fontsize = 18)
plt.show()
```

```
Classification report:

               precision    recall  f1-score   support

           0       1.00      0.94      0.97       151
           1       0.93      1.00      0.96       124

    accuracy                           0.97       275
   macro avg       0.97      0.97      0.97       275
weighted avg       0.97      0.97      0.97       275

Confusion Matrix
 [[142   9]
 [  0 124]]

Accuracy
 96.73 %

C:\Users\KISHORE KUMAR A V\AppData\Local\Programs\Python\Python39\lib\site-packages\sklearn\utils\validation.py:1111: DataC
onversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples, ),
for example using ravel().
  y = column_or_1d(y, warn=True)
C:\Users\KISHORE KUMAR A V\AppData\Local\Programs\Python\Python39\lib\site-packages\sklearn\utils\deprecation.py:87: Future
Warning: Function plot_roc_curve is deprecated; Function :func:`plot_roc_curve` is deprecated in 1.0 and will be removed in
1.2. Use one of the class methods: :meth:`sklearn.metric.RocCurveDisplay.from_predictions` or :meth:`sklearn.metric.RocCurv
eDisplay.from_estimator`.
  warnings.warn(msg, category=FutureWarning)
```



In [19]:

```
# poly linear
from sklearn.svm import SVC
svm = SVC(kernel = 'linear', random_state = 8)
svm.fit(x_train, y_train)

# Predicting the test set results
test_pred = svm.predict(x_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score
class_report = classification_report(y_test, test_pred)
conf_matrix = confusion_matrix(y_test, test_pred)
acc = accuracy_score(y_test,test_pred)

print("Classification report:\n\n", class_report)
print("Confusion Matrix\n",conf_matrix)
print("\nAccuracy\n","{0:.2f}".format(acc*100),"%")
results = []
results.append(("SupportVectorMachine",class_report, conf_matrix, acc))
from sklearn import metrics
metrics.plot_roc_curve(svm, x_test, y_test)
plt.title("ROC Curve", fontsize = 18)
plt.show()
```

```
C:\Users\KISHORE KUMAR A V\AppData\Local\Programs\Python\Python39\lib\site-packages\sklearn\utils\validation.py:1111: DataC
onversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples, ),
for example using ravel().
  y = column_or_1d(y, warn=True)
C:\Users\KISHORE KUMAR A V\AppData\Local\Programs\Python\Python39\lib\site-packages\sklearn\utils\deprecation.py:87: Future
Warning: Function plot_roc_curve is deprecated; Function :func:`plot_roc_curve` is deprecated in 1.0 and will be removed in
1.2. Use one of the class methods: :meth:`sklearn.metric.RocCurveDisplay.from_predictions` or :meth:`sklearn.metric.RocCurv
eDisplay.from_estimator`.
  warnings.warn(msg, category=FutureWarning)
```

Classification report:

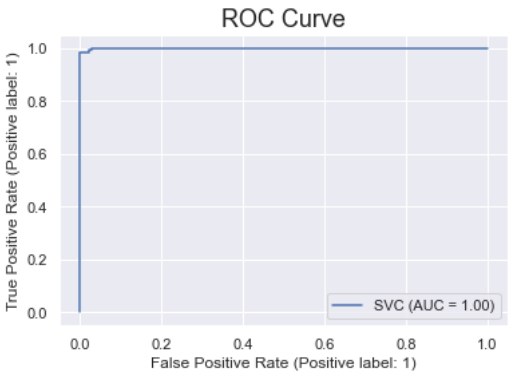
	precision	recall	f1-score	support
0	0.99	0.97	0.98	151
1	0.97	0.99	0.98	124
accuracy			0.98	275
macro avg	0.98	0.98	0.98	275
weighted avg	0.98	0.98	0.98	275

Confusion Matrix

```
 [[147   4]
 [  1 123]]
```

Accuracy

```
 98.18 %
```



In [20]:

```
print(x_test[225])
print(y_test[225])
```

```
[-1.2576   1.5892   7.0078   0.42455]
[0]
```

In [21]:

```
print(svm.predict([[-1.4106,  -7.108,    5.6454,   0.31335]]))
```

```
[1]
```

In [22]:

```
# Feature scaling
from sklearn.preprocessing import StandardScaler
sc_X = StandardScaler()
X_Train = sc_X.fit_transform(x_train)
X_Test = sc_X.transform(x_test)
```

In [23]:

```
from sklearn.svm import SVC
classifier_std = SVC(kernel = 'linear', random_state = 8)
classifier_std.fit(X_Train, y_train)

# Predicting the test set results
train_pred_std = classifier_std.predict(X_Train)
test_pred_std = classifier_std.predict(X_Test)

from sklearn.metrics import accuracy_score, confusion_matrix, classification_report

print("std Training data Accuracy score with linear kernel :", "{0:.2f}".format(accuracy_score(y_train, train_pred_std)*100),"%")
print("std Testing data Accuracy score with linear kernel :", "{0:.2f}".format(accuracy_score(y_test, test_pred_std)*100),"%")
```

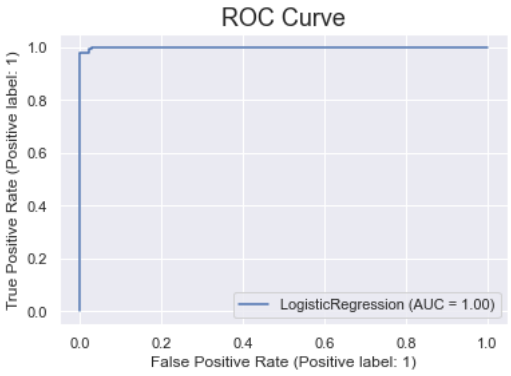
```
std Training data Accuracy score with linear kernel : 98.54 %
std Testing data Accuracy score with linear kernel : 98.18 %

C:\Users\KISHORE KUMAR A V\AppData\Local\Programs\Python\Python39\lib\site-packages\sklearn\utils\validation.py:1111: DataC
onversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples, ),
for example using ravel().
  y = column_or_1d(y, warn=True)
```

Logistic regression

In [24]:

```
from sklearn.linear_model import LogisticRegression

log = LogisticRegression()
log.fit(x_train,y_train)

pred = log.predict(x_test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

class_report = classification_report(y_test, pred)
conf_matrix = confusion_matrix(y_test,pred)
acc = accuracy_score(y_test,pred)

print("Classification report:\n\n", class_report)
print("Confusion Matrix\n",conf_matrix)
print("\nAccuracy\n","{0:.2f}".format(acc*100),"%")
from sklearn import metrics
metrics.plot_roc_curve(log, x_test, y_test)
plt.title("ROC Curve", fontsize = 18)
plt.show()
```

```
Classification report:

               precision    recall  f1-score   support

           0       1.00      0.97      0.99       151
           1       0.97      1.00      0.98       124

    accuracy                           0.99       275
   macro avg       0.98      0.99      0.99       275
weighted avg       0.99      0.99      0.99       275

Confusion Matrix
 [[147   4]
 [  0 124]]

Accuracy
 98.55 %

C:\Users\KISHORE KUMAR A V\AppData\Local\Programs\Python\Python39\lib\site-packages\sklearn\utils\validation.py:1111: DataC
onversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples, ),
for example using ravel().
  y = column_or_1d(y, warn=True)
C:\Users\KISHORE KUMAR A V\AppData\Local\Programs\Python\Python39\lib\site-packages\sklearn\utils\deprecation.py:87: Future
Warning: Function plot_roc_curve is deprecated; Function :func:`plot_roc_curve` is deprecated in 1.0 and will be removed in
1.2. Use one of the class methods: :meth:`sklearn.metric.RocCurveDisplay.from_predictions` or :meth:`sklearn.metric.RocCurv
eDisplay.from_estimator`.
  warnings.warn(msg, category=FutureWarning)
```



In [25]:

```
from sklearn.linear_model import LogisticRegression
from sklearn.preprocessing import StandardScaler

sc_X = StandardScaler()
X_Train = sc_X.fit_transform(x_train)
X_Test = sc_X.transform(x_test)

model = LogisticRegression()
model.fit(X_Train,y_train)

pred = model.predict(X_Test)

from sklearn.metrics import classification_report, confusion_matrix, accuracy_score

class_report = classification_report(y_test, pred)
conf_matrix = confusion_matrix(y_test,pred)
acc = accuracy_score(y_test,pred)

print("Classification report:\n\n", class_report)
print("Confusion Matrix\n",conf_matrix)
print("\nAccuracy\n","{0:.2f}".format(acc*100),"%")
results.append(("LogisticRegression",class_report, conf_matrix, acc))
```

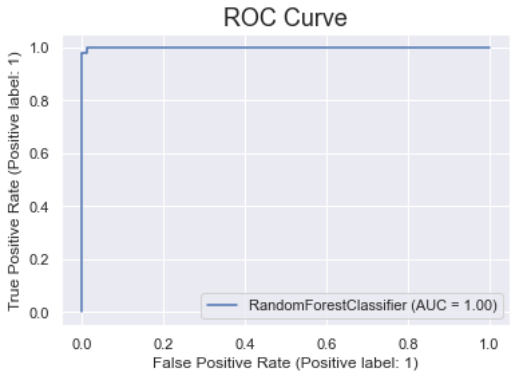
```
Classification report:

               precision    recall  f1-score   support

           0       1.00      0.97      0.98       151
           1       0.96      1.00      0.98       124

    accuracy                           0.98       275
   macro avg       0.98      0.98      0.98       275
weighted avg       0.98      0.98      0.98       275

Confusion Matrix
 [[146   5]
 [  0 124]]

Accuracy
 98.18 %

C:\Users\KISHORE KUMAR A V\AppData\Local\Programs\Python\Python39\lib\site-packages\sklearn\utils\validation.py:1111: DataC
onversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples, ),
for example using ravel().
  y = column_or_1d(y, warn=True)
```

Random Forest

In [26]:

```
from sklearn.ensemble import RandomForestClassifier

rfc = RandomForestClassifier()

rfc.fit(x_train, y_train)

pred = rfc.predict(x_test)

class_report = classification_report(y_test, pred)
conf_matrix = confusion_matrix(y_test,pred)
acc = accuracy_score(y_test,pred)

print("Classification report:\n\n", class_report)
print("Confusion Matrix\n",conf_matrix)
print("\nAccuracy\n","{0:.2f}".format(acc*100),"%")
results.append(("RandomForestClassifier",class_report, conf_matrix, acc))
from sklearn import metrics
metrics.plot_roc_curve(rfc, x_test, y_test)
plt.title("ROC Curve", fontsize = 18)
plt.show()
```

```
C:\Users\KISHORE KUMAR A V\AppData\Local\Temp\ipykernel_20340\4081757492.py:5: DataConversionWarning: A column-vector y was
passed when a 1d array was expected. Please change the shape of y to (n_samples,), for example using ravel().
  rfc.fit(x_train, y_train)

Classification report:

               precision    recall  f1-score   support

           0       0.99      0.99      0.99       151
           1       0.98      0.98      0.98       124

    accuracy                           0.99       275
   macro avg       0.99      0.99      0.99       275
weighted avg       0.99      0.99      0.99       275

Confusion Matrix
 [[149   2]
 [  2 122]]

Accuracy
 98.55 %

C:\Users\KISHORE KUMAR A V\AppData\Local\Programs\Python\Python39\lib\site-packages\sklearn\utils\deprecation.py:87: Future
Warning: Function plot_roc_curve is deprecated; Function :func:`plot_roc_curve` is deprecated in 1.0 and will be removed in
1.2. Use one of the class methods: :meth:`sklearn.metric.RocCurveDisplay.from_predictions` or :meth:`sklearn.metric.RocCurv
eDisplay.from_estimator`.
  warnings.warn(msg, category=FutureWarning)
```



In [27]:

```
from sklearn.ensemble import RandomForestClassifier

rfc = RandomForestClassifier(n_estimators = 200, random_state = 40)

rfc.fit(X_Train, y_train)

pred = rfc.predict(X_Test)

class_report = classification_report(y_test, pred)
conf_matrix = confusion_matrix(y_test,pred)
acc = accuracy_score(y_test,pred)

print("Classification report:\n\n", class_report)
print("Confusion Matrix\n",conf_matrix)
print("\nAccuracy\n","{0:.2f}".format(acc*100),"%")
```

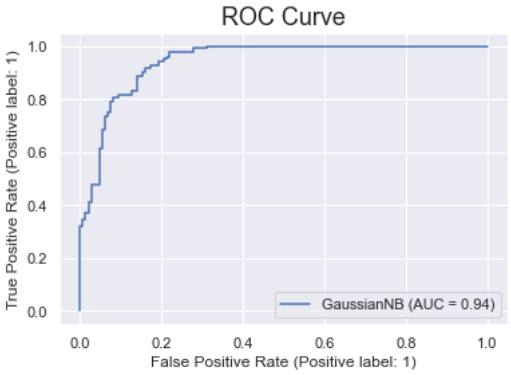
```
C:\Users\KISHORE KUMAR A V\AppData\Local\Temp\ipykernel_20340\1858532376.py:5: DataConversionWarning: A column-vector y was
passed when a 1d array was expected. Please change the shape of y to (n_samples,), for example using ravel().
  rfc.fit(X_Train, y_train)

Classification report:

               precision    recall  f1-score   support

           0       0.99      0.99      0.99       151
           1       0.98      0.98      0.98       124

    accuracy                           0.99       275
   macro avg       0.99      0.99      0.99       275
weighted avg       0.99      0.99      0.99       275

Confusion Matrix
 [[149   2]
 [  2 122]]

Accuracy
 98.55 %
```

Naive Bayes

In [28]:

```
from sklearn.naive_bayes import GaussianNB

gb = GaussianNB()

gb.fit(x_train, y_train)

pred = gb.predict(x_test)

class_report = classification_report(y_test, pred)
conf_matrix = confusion_matrix(y_test,pred)
acc = accuracy_score(y_test,pred)

print("Classification report:\n\n", class_report)
print("Confusion Matrix\n",conf_matrix)
print("\nAccuracy\n","{0:.2f}".format(acc*100),"%")
results.append(("Naive Bayes       ",class_report, conf_matrix, acc))
from sklearn import metrics
metrics.plot_roc_curve(gb, x_test, y_test)
plt.title("ROC Curve", fontsize = 18)
plt.show()
```

```
Classification report:

               precision    recall  f1-score   support

           0       0.86      0.87      0.87       151
           1       0.84      0.82      0.83       124

    accuracy                           0.85       275
   macro avg       0.85      0.85      0.85       275
weighted avg       0.85      0.85      0.85       275

Confusion Matrix
 [[132  19]
 [ 22 102]]

Accuracy
 85.09 %

C:\Users\KISHORE KUMAR A V\AppData\Local\Programs\Python\Python39\lib\site-packages\sklearn\utils\validation.py:1111: DataC
onversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples, ),
for example using ravel().
  y = column_or_1d(y, warn=True)
C:\Users\KISHORE KUMAR A V\AppData\Local\Programs\Python\Python39\lib\site-packages\sklearn\utils\deprecation.py:87: Future
Warning: Function plot_roc_curve is deprecated; Function :func:`plot_roc_curve` is deprecated in 1.0 and will be removed in
1.2. Use one of the class methods: :meth:`sklearn.metric.RocCurveDisplay.from_predictions` or :meth:`sklearn.metric.RocCurv
eDisplay.from_estimator`.
  warnings.warn(msg, category=FutureWarning)
```



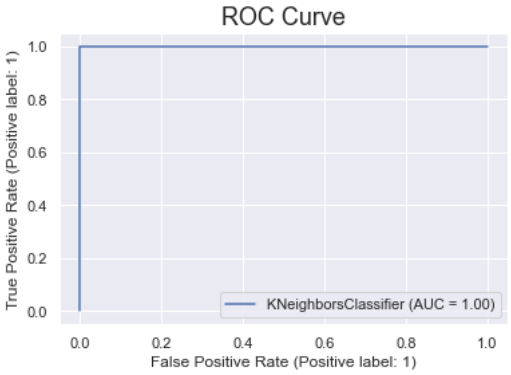
KNN

In [29]:

```
from sklearn.neighbors import KNeighborsClassifier

knn = KNeighborsClassifier(n_neighbors=27)

knn.fit(x_train, y_train)

pred = knn.predict(x_test)

class_report = classification_report(y_test, pred)
conf_matrix = confusion_matrix(y_test,pred)
acc = accuracy_score(y_test,pred)

print("Classification report:\n\n", class_report)
print("Confusion Matrix\n",conf_matrix)
print("\nAccuracy\n","{0:.2f}".format(acc*100),"%")
results.append(("KNearestNeighbors",class_report, conf_matrix, acc))
from sklearn import metrics
metrics.plot_roc_curve(knn, x_test, y_test)
plt.title("ROC Curve", fontsize = 18)
plt.show()
```

```
C:\Users\KISHORE KUMAR A V\AppData\Local\Programs\Python\Python39\lib\site-packages\sklearn\neighbors\_classification.py:200: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples,), for example using ravel().
  return self._fit(X, y)
C:\Users\KISHORE KUMAR A V\AppData\Local\Programs\Python\Python39\lib\site-packages\sklearn\utils\deprecation.py:87: FutureWarning: Function plot_roc_curve is deprecated; Function :func:`plot_roc_curve` is deprecated in 1.0 and will be removed in 1.2. Use one of the class methods: :meth:`sklearn.metric.RocCurveDisplay.from_predictions` or :meth:`sklearn.metric.RocCurveDisplay.from_estimator`.
  warnings.warn(msg, category=FutureWarning)
```

```
Classification report:

               precision    recall  f1-score   support

           0       1.00      0.99      1.00       151
           1       0.99      1.00      1.00       124

    accuracy                           1.00       275
   macro avg       1.00      1.00      1.00       275
weighted avg       1.00      1.00      1.00       275

Confusion Matrix
 [[150   1]
 [  0 124]]

Accuracy
 99.64 %
```



In [30]:

```
from sklearn.neighbors import KNeighborsClassifier

model = KNeighborsClassifier(n_neighbors=39)

model.fit(X_Train, y_train)

pred = model.predict(X_Test)

class_report = classification_report(y_test, pred)
conf_matrix = confusion_matrix(y_test,pred)
acc = accuracy_score(y_test,pred)

print("Classification report:\n\n", class_report)
print("Confusion Matrix\n",conf_matrix)
print("\nAccuracy\n","{0:.2f}".format(acc*100),"%")
```

```
Classification report:

               precision    recall  f1-score   support

           0       1.00      0.98      0.99       151
           1       0.98      1.00      0.99       124

    accuracy                           0.99       275
   macro avg       0.99      0.99      0.99       275
weighted avg       0.99      0.99      0.99       275

Confusion Matrix
 [[148   3]
 [  0 124]]

Accuracy
 98.91 %

C:\Users\KISHORE KUMAR A V\AppData\Local\Programs\Python\Python39\lib\site-packages\sklearn\neighbors\_classification.py:20
0: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_sam
ples,), for example using ravel().
  return self._fit(X, y)
```

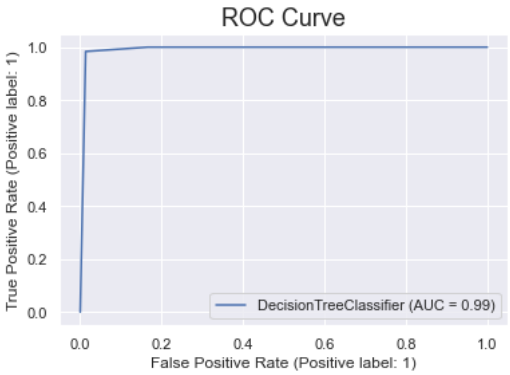
Decision Tree (Gini algorithm)

In [31]:

```
from sklearn.tree import DecisionTreeClassifier

dtc = DecisionTreeClassifier(criterion = "gini", random_state = 15, max_depth = 5)

dtc.fit(x_train, y_train)

pred = dtc.predict(x_test)

class_report = classification_report(y_test, pred)
conf_matrix = confusion_matrix(y_test,pred)
acc = accuracy_score(y_test,pred)

print("Classification report:\n\n", class_report)
print("Confusion Matrix\n",conf_matrix)
print("\nAccuracy\n","{0:.2f}".format(acc*100),"%")
results.append(("DecisionTrees       ",class_report, conf_matrix, acc))
from sklearn import metrics
metrics.plot_roc_curve(dtc, x_test, y_test)
plt.title("ROC Curve", fontsize = 18)
plt.show()
```

```
C:\Users\KISHORE KUMAR A V\AppData\Local\Programs\Python\Python39\lib\site-packages\sklearn\utils\deprecation.py:87: Future
Warning: Function plot_roc_curve is deprecated; Function :func:`plot_roc_curve` is deprecated in 1.0 and will be removed in
1.2. Use one of the class methods: :meth:`sklearn.metric.RocCurveDisplay.from_predictions` or :meth:`sklearn.metric.RocCurv
eDisplay.from_estimator`.
  warnings.warn(msg, category=FutureWarning)
```

```
Classification report:

               precision    recall  f1-score   support

           0       0.99      0.99      0.99       151
           1       0.98      0.98      0.98       124

    accuracy                           0.99       275
   macro avg       0.99      0.99      0.99       275
weighted avg       0.99      0.99      0.99       275

Confusion Matrix
 [[149   2]
 [  2 122]]

Accuracy
 98.55 %
```



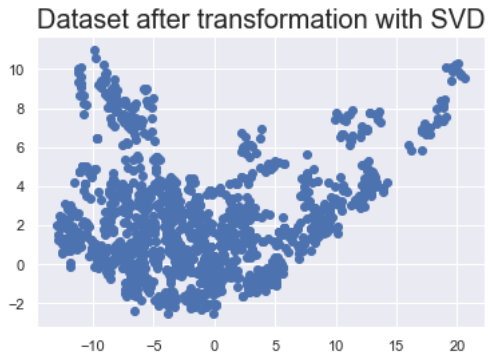
K-Means Clustering

Now we'll use the unsupervised learning algorithm KMeans to find clusters in the dataset without using the counterfeit column to see if it will be capable to separate well the dataset in two clusters.

K-means with SVD

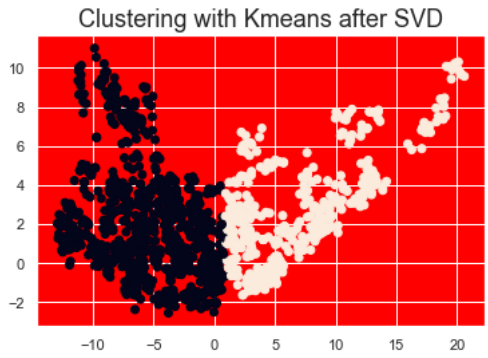
In [32]:

```
from sklearn.decomposition import TruncatedSVD
svd = TruncatedSVD(n_components = 2, random_state = 0)

transf = svd.fit_transform(independent)

plt.scatter(x = transf[:,0], y = transf[:,1])
plt.title("Dataset after transformation with SVD", fontsize = 20)
plt.show()
```



In [33]:

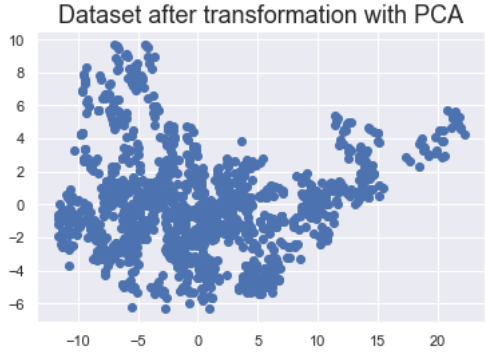
```
from sklearn.cluster import KMeans

km = KMeans(n_clusters = 2)
c = km.fit_predict(transf)
ax = plt.axes()
ax.set_facecolor("red")
plt.scatter(x = transf[:,0], y = transf[:,1], c=c)
plt.title("Clustering with Kmeans after SVD", fontsize = 18)
plt.show()
```



K-means with PCA

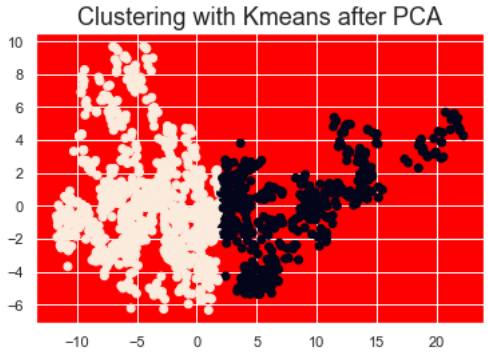
In [34]:

```
from sklearn.decomposition import PCA
pca = PCA(n_components = 2, random_state = 0)

transf = pca.fit_transform(independent)

plt.scatter(x = transf[:,0], y = transf[:,1])
plt.title("Dataset after transformation with PCA", fontsize = 18)
plt.show()
```



In [35]:

```
km = KMeans(n_clusters = 2)
c = km.fit_predict(transf)
ax = plt.axes()
ax.set_facecolor("red")
plt.scatter(x = transf[:,0], y = transf[:,1], c = c)
plt.title("Clustering with Kmeans after PCA", fontsize = 18)
plt.show()
```

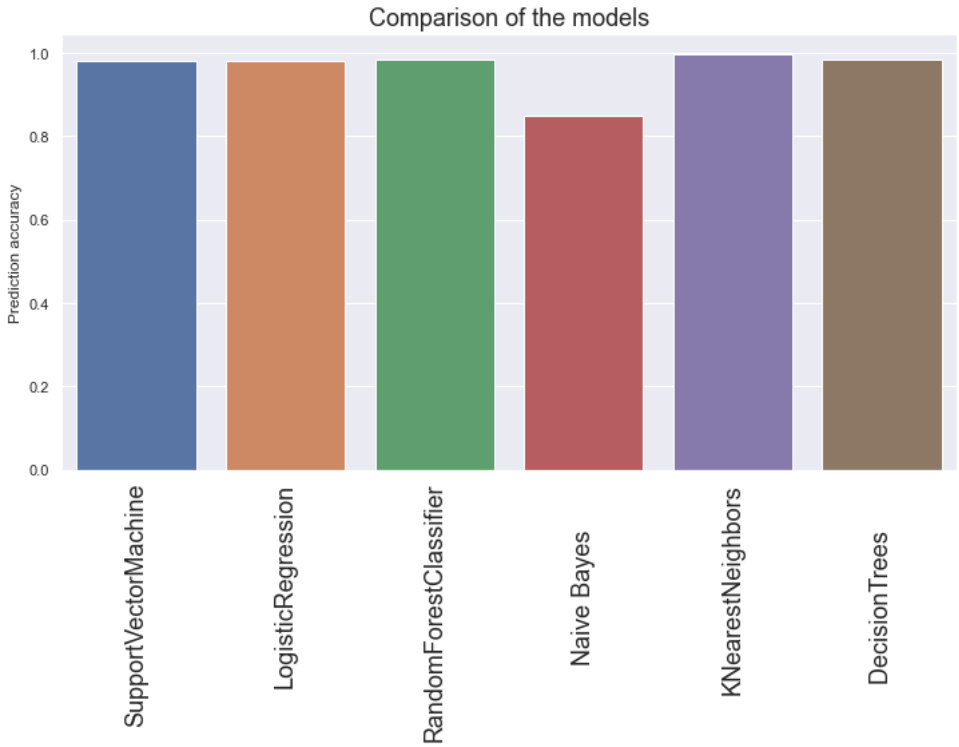


Comparison of the models¶

In [36]:

```
labels  = []
height = []
for i in range(len(results)):
    labels.append(results[i][0])
    height.append(results[i][-1])

plt.figure(figsize = (12,6))
ax = sns.barplot(labels,height)
ax.set_xticklabels(labels, fontsize = 18, rotation = 90)
plt.title("Comparison of the models", fontsize = 18)
plt.ylabel("Prediction accuracy")
plt.show()
```

```
C:\Users\KISHORE KUMAR A V\AppData\Local\Programs\Python\Python39\lib\site-packages\seaborn\_decorators.py:36: FutureWarnin
g: Pass the following variables as keyword args: x, y. From version 0.12, the only valid positional argument will be `data
`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.
  warnings.warn(
```



In [37]:

```
print("Algorithm \t\t\t Accuracy")
print("--------- \t\t\t --------")
print()
for i in results:
    print(i[0],"\t\t" ,"{0:.2f}".format(i[3]*100),"%")
```

```
Algorithm                       Accuracy
---------                       --------

SupportVectorMachine            98.18 %
LogisticRegression              98.18 %
RandomForestClassifier          98.55 %
Naive Bayes                     85.09 %
KNearestNeighbors               99.64 %
DecisionTrees                   98.55 %
```